Republic of Kenya

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KS 1242 (2012) (English): Method of test for Cordages (Draft Standard)

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KENYA STANDARD

KS 1242:2012
ICS 59.060.10

Method of test for Cordages

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In order to keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

KENYA STANDARD

KS 1242: 2012
ICS 59.060.10

Methods of test for Cordages

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Foreword

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This Kenya Standard was prepared by the Technical Committee on Hard Fibres and Related Products under the direction of the Projects Standards Committee, and it is in accordance with the procedures of the Bureau.

The standard is a collection of the important physical test methods applicable to cordages made from natural and man-made fibres. In the second edition of this Kenya standard, a formula on Linear density under clause 5.1.1.5 has been corrected.

In the development of this standard, reference was made to the following documents:

ISO 2307: 1990 (E) Ropes — Determination of certain physical and mechanical properties.

BS 5053: 1985 Methods of test for cordages and webbing slings and for fibre cores for wire ropes.

Acknowledgement is hereby made for the assistance received from these sources.

1 Scope

This Kenya Standard describes methods of test for cordages made from either natural or man-made fibres.

2 Normative references

The following standards are indispensable in the application of this standard:

KS 1037 Methods of test for woven bags
KS 641Glossary of terms for ropes and Cordages
KS 32 Conditions for testing textiles

3 Definitions

For the purposes of this standard, the following definitions, together with those given in KS 08-641 apply:

3.1 cordage
A load bearing article made by assembling fibres or filaments with twisting or plaiting, including twines, lines and ropes.

3.2 twine
A twisted cordage less than 4 mm in diameter.

3.3 line
Laid, cabled or plaited cordage less than 4 mm in diameter.

3.4 rope
An article of cordage more than 4 mm in diameter obtained when:

(*a*) three or more strands are laid or plaited together, or

(*b*) a core is covered by a braided or plastic film sheath.

3.5 batch
The definite quantity of a commodity manufactured or produced under conditions presumed uniform, consisting of articles of the same type and dimensions.

3.6 laboratory sample
The total selection of samples from a batch intended for the laboratory for testing.

3.7 Specimen
A quantity of cordage on which a test complying with the requirements of this standard is carried out.

3.8 Package
The unit of packaging in which the goods are supplied.

4. Sampling

4.1 Baler Twines and other Twines made-up into Spools
Determine the number of spools "*S*" in a laboratory sample by the equation:

$$S = 0.25\sqrt{N}$$

where,

N = the number of spools in a batch.

Where the calculated value of "S" is not a whole number, round off the value obtained to the nearest whole number, for example 29.5 and 25.44 shall be rounded off to 30 and 25 respectively. Where $S < 1$, take one sample length.

4.2 Lines and Twines made-up in Packages other than Spools
Determine the number of laboratory samples "S" by the equation:

$$S = 0.25\sqrt{N}$$

where,

N = the number of packages making up the batch.

Where the calculated value of "S" is not a whole number, round off the value obtained to the nearest whole number (*see* 3.1)

Where $S < 1$, take one sample length.

4.3 Ropes
Determine the number of laboratory samples "S" by the equation:

$$S = 0.4\sqrt{N}$$

where,

N = the number of coils making up the batch.

Where the calculated value of "S" is not a whole number, the value obtained shall be rounded off to the nearest whole number (*see* 3.1). Where $S<1$, take one sample length.

4.4 Selection of Laboratory Sample
Select at random the required number of packages, as determined from the equation in 3.1, 3.2 and 3.3, ensuring that each package is taken from different bales (or bundles) of the batch.

5. Conditioning

Conduct all tests under ordinary room conditions of temperature and humidity. However, in case of dispute, conduct the tests on samples which have been conditioned for 48 hours in the standard atmosphere for textile testing as defined in KS 08-32

6. Testing

6.1 Twines and Lines
Natural and man-made.

6.1.1 *Determination of Linear Density and Runnage.*

6.1.1.1 *Principle*
Weighing, under specific conditions, specimens of specified length, then calculation of the linear density and runnage (or length, in metres, per kilogram).

6.1.1.2 *Apparatus*

(a) *Balance*
Accurate to 0.5 g.

(b) Wrap-reel
Of known perimeter.

6.1.1.3 *Selection of specimen*
Select 30 m of twine from each package. In case of spools, proceed as follows:

Draw directly from the centre of each spool, in anti-clockwise direction, the first 10 m of twine and discard them;

Then draw 30 m of twine and wind as adjacent turn (without overlapping) on the wrap-reel, exercising just sufficient tension on the twine to maintain straightness.

Each length of 30 m thus obtained constitutes a specimen.

6.1.1.4 *Procedure*
Weigh each specimen to the nearest 0.5 g (let m_1 be the mass obtained in grams).

6.1.1.5 *Calculations and expression of results*

(a) *Calculation of linear density*
For each specimen, calculate the linear density "*T*" in tex, using the formula:

$$T = \frac{1000\, m_1}{30}$$

where,

m_1 = the mass, in grams, of the specimen.

(*b*) *Calculation of runnage*
Calculate the runnage "*L*", in metres per kilogram of twine using the following formula:

$$L = \frac{10^6}{T}$$

where,

L = the linear density in tex.

(*c*) *Check test*
If any specimen is outside the tolerance, a check test shall be carried out on another spool.

If the results of the check test is found to be within the limits of the permitted tolerances, it is the result of the check test which is adopted for the value of the linear density.

6.1.2 *Determination of Breaking Force*

6.1.2.1 *Principle*
Measurement of force (expressed in decaNewtons) necessary to break, under prescribed conditions, a specimen of specified length.

6.1.2.2 *Apparatus*

Tensile testing machine, having a constant rate of traverse, with a mobile grip. This testing machine should comprise:

(*a*) Two devices for gripping and guiding the ends of the test piece (e.g. bollards), in order to achieve an indirect pull on the test piece.

(*b*) A device for maintaining the rate of traverse constant.

(*c*) A device for indicating or continuously recording the force applied.

6.1.2.3 *Specimen selection*

After determining the runnage, select from the package (or in case of spool, draw directly from the centre of each spool in an anti-clockwise direction), and without cutting the twine/line, ten specimens spaced 5 m from each other and of sufficient length so that once they are mounted in the testing machine, the free length of the specimen between the gripping devices (5.1.2.2 (*a*)) is a minimum of 500 mm in case of natural fibres or 250 mm for man-made fibres.

Each specimen shall be identified by reference to the package from which it has been drawn.

6.1.2.4 *Procedure:*

(*a*) Before mounting the test piece between the grips (5.1.2.2 (*a*)), check that the axes of the latter are minimum of 500 mm (natural fibres) or 250 mm (man-made fibres) apart.

(*b*) Check that the speed of movement of the moving grip of the machine is constant and numerically equal, in millimetres per minute, within ± 10 %, to the length, in millimetres of the specimen between the grips.

(*c*) Start the machine and apply the force continuously until the specimen breaks. If a specimen breaks in the grips, or as a result of damage caused by them, remove it and start the test again with a new specimen.

6.1.2.5 *Expression of results*

For the breaking force test, take into consideration only the results obtained when the break occurs between the grips of the testing machine.

If any one of the specimens from a sample package fails to reach the minimum breaking force specified in the table for the twine being tested, the result shall be rejected and another package of twine sampled in its place.

This retest procedure is applicable to all sample packages representing a batch.

Should any test results from the retest sample package or packages fail to reach the minimum breaking force requirement, the batch represented by the sample packages shall be deemed not to comply with this Kenya Standard.

6.1.3 *Determination of Diameter*

6.1.3.1 *Principle*

Measurement of diameter under a given tension in different points along the twine length using a vernier caliper.

6.1.3.2 *Apparatus*

A vernier caliper, accurate to 0.5 mm.

6.1.3.3 *Specimens*

Select the specimens as in 5.1.1.3.

6.1.3.4 *Procedure*
Take measurements at five equally spaced places along the specimen. Record the result in mm and take the mean of the readings.

6.1.3.5 *Expression of results*
The mean of the readings is the diameter of the specimen in mm.

6.1.4 *Determination of Extractable Lubricant (Natural Fibres)*

6.1.4.1 *Principle*

Extraction by a suitable solvent of lubricants contained in a specific mass of twine, then weighing of the lubricant residue after removing the solvent and drying.

6.1.4.2 *Apparatus:*

(*a*) Balance accurate to 0.05 g.

(*b*) Soxhlet extraction apparatus.

(*c*) Extraction cartridges for soxhlet apparatus.

(*d*) Oven, adjustable to 103 ± 2 °C.

6.1.4.3 *Specimen selection*
Select from each package in the laboratory sample about 10 g of twine and enclose the total mass thus selected in a plastic bag.

6.1.4.4 *Procedure*
Select a representative specimen, of mass at least 40 g, from the total mass obtained in 5.1.4.3. If this cannot be extracted in one operation, divide this specimen into two and extract the two parts separately.

Weigh the specimen or specimens together to the nearest 0.05 g. Place them in an extraction cartridge and insert them into the soxhlet apparatus after calibrating the extraction flask of the apparatus. Extract the lubricant for approximately 4 h. Remove the excess solvent by distillation, then dry the lubricant residue in the oven, regulated at 103 ± 2 °C, for 3 h. Cool to room temperature and weigh again.

6.1.4.5 *Expression of results*
Calculate the extractable lubricant, *W*, expressed as a percentage of the total mass of the specimens, using the following formula:

$$W = \frac{100\, m_L}{m_S}$$

where,

m_L = the mass, in grams, of extractable lubricant;

m_S = the total mass, in grams, of the specimens.

If necessary, take the mean of the two results obtained.

6.2 Ropes
Natural and Man-made

NOTE: The following tests on ropes may be performed successively on a single specimen without removal from the machine.

6.2.1 *Specimens*

6.2.1.1 *Specimen length*
The specimen shall be of adequate length to give an effective length (*see* 5.2.5.3) at least equal to the one given in Table 1, when mounted on the tensile testing machine.

TABLE 1. EFFECTIVE LENGTHS

TYPE OF ROPE	TYPE OF TESTING MACHINE	MINIMUM EFFECTIVE LENGTH *L*u, NECESSARY FOR TESTING, mm
Man-made fibre ropes reference number ≤ 10 (nominal diameter ≤ 10 mm)	All types	400
Man-made fibre ropes reference number > 10 (nominal diameter > 10)	Wedge grip or cors de chasse machines	600
	Others	1800
Natural fibre ropes	All types	2000

6.2.1.2 *Number of specimens*
Take a specimen from each laboratory sample.

6.2.1.3 *Selection of the specimen*
Select the specimen either from one end of the samples or from the body of the samples if these are intended to be cut. Take all necessary steps to prevent unlaying. If necessary, remove slightly unlaid ends.

6.2.2 *Determination of Linear Density*

6.2.2.1 *Principle*

Weighing, under given conditions, specimens of specified lengths, then calculating the linear density.

6.2.2.2 *Apparatus*
Balance accurate to 0.5 g.

6.2.2.3 *Procedure*
Determine the mass of the specimen. Let *m* be this mass in grams. Lay the specimen out straight without undue tension on a flat surface. Measure its length. Let L_o be this length in metres.

6.2.2.4 *Calculation and expression of results*
The linear density (net mass, in grams, per metre) expressed in kilotex is given by the equation:

$$\rho_1 = \frac{m}{L_1}$$

where,

m = the mass, in grams, of the specimen;

L_1 = the length, in metres, of the specimen under the reference tension, given by the equation:

$$L_1 = \frac{L_2 + L_o}{L_o}$$

L_o being the initial gauge length, measured as described in 5.2.2.3;

L_2 being the gauge length, in metres, under the reference tension, measured as in 5.2.5.3;

6.2.3 *Determination of Lay*

6.2.3.1 *Principle*

The specimen is subjected to the appropriate reference, tension and measurement taken.

6.2.3.2 *Procedure*
Mount the specimen on the testing machine as described in 5.2.5.3. Apply the reference tension specified for the type of rope being tested (*see* Table 2) to the test piece. Measure the length between *n* complete turns of the same strand or, in the case of plaited rope the distance between *n* successive plaits. Let L_1 be this length, expressed in metres.

6.2.3.3 *Calculations and expression of results*
The lay *p*, expressed in metres, is given by the equation:

$$p = \frac{L_1}{n}$$

where,

L_1 = the length of *n* complete turns of the same strand or in the case of plaited ropes, the length between *n* successive plait points (*see* Figures 1 and 2).

6.2.4 *Determination of Diameter*

6.2.4.1 *Principle*

The specimen is subjected to the appropriate reference tension and measurement taken using a vernier caliper.

6.2.4.2 *Procedure*

Apply the reference tension specified for the type of rope being tested (*see* Table 2) to the specimen. Measure the diameter of the rope in millimetres, using a vernier caliper in five equally spaced points along the rope, taking care to ensure that the jaws rest on the outside of the strands.

NOTE: Measurement of diameter is not valid for 8-strand plaited ropes.

6.2.4.3 *Calculations and expression of results*

Calculate the arithmetic mean of the five readings and report the result as the diameter of specimen in mm.

6.2.5 *Determination of Breaking Force*

6.2.5.1 *Principle*

Measurement of the force (expressed in kiloNewtons) necessary to break, under known conditions, a

specimen of specified length.

6.2.5.2 *Apparatus*

Tensile testing machine, accommodating the assumed breaking strength of the rope, which allows a constant rate of traverse of the moving element as stipulated in 5.2.5.3 and measurement of breaking load to an accuracy of 1 %.

Machines with the following types of grips may be used:

(*a*) Wedge grips (*see* Figure 3);

(*b*) Bollard grips (*see* Figure 4);

(*c*) Pulley-type grips (cors de chasse) (*see* Figure 5).

In the case of bollard grips, the diameter of the bollards passing through the eye-spliced specimens shall be at least double the diameter of the rope to be tested. In the case of cors de chasse grips, the diameter of the pulleys or catches holding down the specimens shall be at least equal to 10 times that of the rope being tested.

6.2.5.3 *Procedure*

Fix the ends of the specimen between the wedge grips or on the cors de chasse or by its eye splices, depending on the type of testing machine used, in order to obtain the effective length of test piece specified in 5.2.1.1.

In the case of a test on splices, the eyes shall have an internal length of between 250 mm and 300 mm when closed. In the case of man-made fibre ropes, it is recommended that the ends of the splices be tapered to finish.

Marks '*r*' limiting the section of the specimen in which rupture is considered as normal shall be position as shown in Figures 3, 4 and 5.

Increase the tension by moving the moving element of the testing machine at a constant rate, selected in such a way that the rate of traverse per minute has a value of between 6 % and 10 % of the effective length of the specimen. For all man-made fibre ropes, the rate of traverse of the moving element shall not exceed 250 mm/min. Continue to increase the tension at the same rate until the specimen breaks.

NOTE: The breaking force and the place on the specimen where the break occurred.

If the breakage occurs outside the limits defined by the marks, start the test again on another specimen, unless the force registered at the time of breaking is not less than 90 % of the minimum specified breaking force.

6.2.5.4 *Expression of results*
Express the breaking force, for each of the specimen in the batch, in newtons, or multiples or sub-multiples thereof, indicating whether breakage took place inside the marks or not.

Any specimen which breaks outside the marks is considered to comply with the tensile strength specifications if the force recorded on breakage is not less than 90 % of the minimum specified breaking strength; in such a case, it is not, however, permitted to report as the test result a breaking force with a value other than the value recorded during the test.

6.2.6 *Determination of Elongation*

6.2.6.1 *Principle*
Measuring and then comparing the lengths of a section of the specimen which has been subjected successively to the reference tension and a tension equal to 75 % of the minimum specified breaking force for the rope.

5.2.6.2 *Apparatus*
See 5.2.5.2.

6.2.6.3 *Procedure*
Mount the specimen on the testing machine as described in 5.2.5.3. Make two marks on the specimen spaced symmetrically with regard to its mid-point and at a distance apart L_o which is greater than 0.5 m.

NOTE: In the case of man-made fibre ropes with a reference number of ≤ 10 (nominal diameter ≤ 10 mm), which have a test piece of effective length such that two marks cannot be made at a distance apart $L_o \geq 0.5$ m and the distance L_2 between these marks cannot be measured as indicated, the value L_o may be obtained by placing two marks at least 0.5 m apart on a sample of rope laid out on a flat surface with no noticeable tension; the value L_2 is obtained by applying the appropriate tension by means of weights and pulleys.

Apply the reference tension as specified in 5.2.3.2, then measure the distance between the two marks. Let L_2 be this distance, expressed in metres to the nearest 0.5 %.

Increase the tension by moving the moving element of the testing machine at a constant rate, selected in such a way that the rate of traverse per minute has a value between 6 % and 10 % of the effective length of the specimen. For all man-made fibre ropes, the rate of traverse of the moving element shall not exceed 250 mm/minute.

When the tensile force reaches 75 % of the minimum breaking force, measure the distance between the marks (the stoppage necessary for measurement shall be as brief as possible). Let L_3 be this distance expressed in metres to the nearest 0.5 %.

6.2.6.4 *Calculation and expression of results*
The value of the elongation A, expressed as a percentage, is given by the equation:

$$A = \frac{(L_3 - L_2) \times 100}{L_2}$$

where

L_2 = the gauge length under reference tension;

L_3 = the gauge length for a tensile force equal to 75 % of the specified minimum breaking force.

6.2.7 *Determination of water repellency*

6.2.7.1 *Principle*
The increase in mass of the rope is determined after immersion in water for a given period.

6.2.7.2 *Specimens*

(*a*) *General*
Cut two specimens each, 500 mm long from the solid rope clear of all loose ends.

(*b*) *Whipping*
Before the rope is cut, securely whip the ends to a maximum 13 mm for ropes up to 24 mm diameter, 20 mm for ropes over 24 mm diameter and not exceeding 48 mm diameter and 25 mm for ropes over 48 mm diameter.

(*c*) *Sealing*
To prevent absorption by capillary action, seal the ends so that the whipping is just covered.

NOTE: A suitable sealing medium is pitch with a small amount of tar added to prevent cracking. Any other satisfactory sealing medium may be used.

6.2.7.3 *Procedure:*

(a) First weighing
Weigh carefully each specimen after whipping and sealing and then place in tap water at a temperature 20 ± 2 °C, care being taken that the specimen is fully submerged, if necessary by weighting to a depth of 150 mm.

Do not under any circumstances, add water after specimens have been submerged. In order to avoid variation in mass due to atmospheric conditions, carry out the weighing immediately before immersion. Do not carry out tests until at least 24 h after completion of manufacture of rope.

(b) Second weighing
After total immersion for 1 h, take out the specimens, and, before weighing, dry them in the following manner. Shake each specimen six times to remove the superfluous water and then roll it on blotting paper until no wetting of the paper is observed. Finally, draw the specimens three times through an absorbent cloth, such as towelling. Then weigh the specimens and again submerge them in water.

(c) Third weighing
After a further period of five-hour immersion, making a total of 6 h in all, dry the specimens as described in 5.2.7.3 (*a*) and weigh them.

(d) Drying of specimens
(e) After the third weighing (*see* 5.2.7.3 (*c*)) thoroughly dry each specimen by gentle heating if necessary. Take care that the sealing is not affected by temperature, and that the temperature does not exceed 50 °C. Dry the specimens to a mass slightly less than that obtained at the first weighing, so that after exposure for at least 4 h to ordinary room conditions of atmosphere, the specimens shall return as nearly as possible to their original mass.

(f) *Fourth, fifth and sixth weighings*

(g) Repeat the procedure described in 5.2.7.3 (*a*), (*b*) and (*c*), with the same specimens.

6.2.7.4 *Expression of results*

Express the gain in mass of each of the specimens as a percentage of the original mass (first and fourth weighings) for 1 h immersion (second and fifth weighings) for 6 h immersion (third and sixth weighings).

7. Test Report

The test report shall contain the following information:

(*a*) A reference to this Kenya Standard;

(*b*) The results obtained, expressed appropriately;

(*c*) The individual values which were used to calculate the results (except for tensile strength values, which will already have been given in item (*b*);

(*d*) The particular test conditions (conditioning of the specimens, type of tensile testing machine used, procedure used for determining elongation);

(*e*) Details of procedure not stipulated in the method, and incidents which are likely to have affected the results.

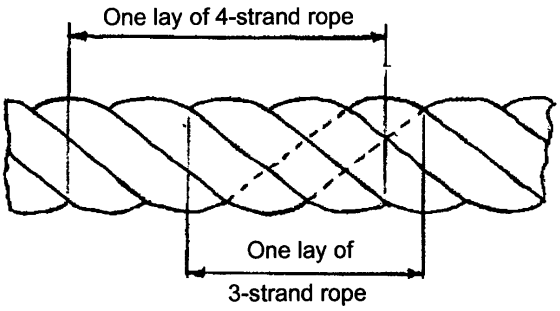

FIG. 1 — LENGTH OF LAY FOR LAID ROPES.

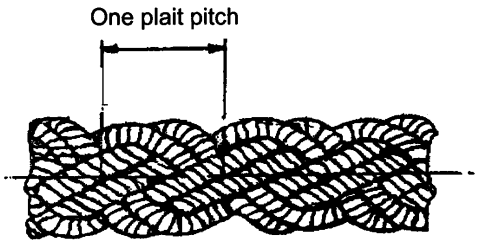

FIG. 2 — LENGTH OF LAY FOR B-STRAND ROPE.

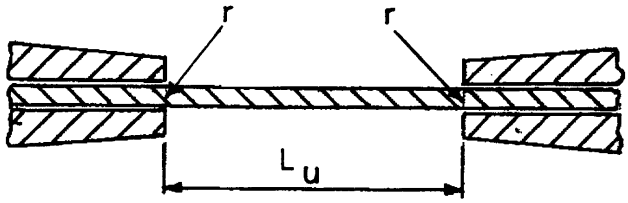

FIG. 3 — TEST PIECE MOUNTED IN WEDGE GRIPS.

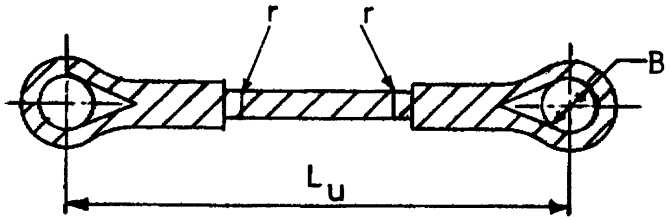

FIG. 4 — EYE-SPLICED TEST PIECE MOUNTED ON BOLLARD GRIPS.

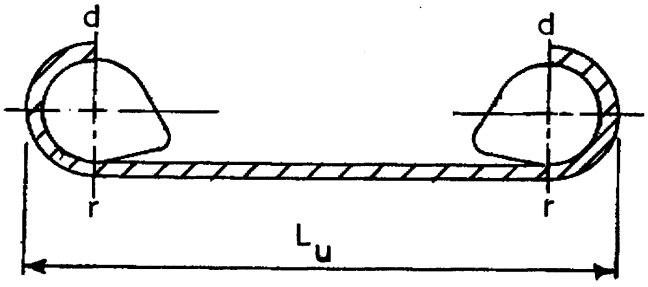

FIG. 5 — TEST PIECE MOUNTED ON COR.DE.CHASSE GRIPS.

TABLE 2. REFERENCE TENSION TO BE APPLIED TO ROPES WHEN MEASURING LINEAR DENSITY AND LAY

REFERENCE NUMBER *	REFERENCE TENSION APPLIED		REFERENCE NUMBER *	REFERENCE TENSION APPLIED	
	Nominal daN	Tolerance		Nominal value daN	Tolerance
4	2	± 5 %	44	240	± 5 %
6	4	± 5 %	48	290	± 5 %
7	6	“	52	340	“
8	8	“	56	390	“
10	12	“	60	440	“
12	18	“	64	500	“
14	24	“	72	650	“
16	32	“	80	800	“
18	40	“	88	950	“
20	50	“	96	1100	“
22	60	“	104	1300	“
24	70	“	112	1500	“
26	85	“	120	1800	“
28	100	“	128	2000	“
30	115	“	136	2300	“
32	130	“	144	2600	“
36	160	“	152	2900	“
40	200	“	160	3800	“

* NOTE: Reference number corresponds to the nominal diameter in mm.